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In This Issue

Puerto Peñasco, Sonora . . *Ronald L. Ives*

Petroleum in Relation to Current Problems —I. Should American Petroleum Imports Be Restricted? . . . . *Nels A. Bengtson*

Are You a Malthusian? . *Roderick Peattie*

Manioc . . . . . *Minnie E. Lemaire*

National Council at Work . *Loyal Durand, Jr.*

Geographical Publications . . . . . .

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Contents

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5. Surveying on the Ground and from the Air
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CONTENTS FOR DECEMBER, 1950

Puerto Peñasco, Sonora. By Ronald L. Ives 349

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Petroleum in Relation to Current Problems—I. Should American Petroleum Imports Be Restricted? By Nels A. Bengtson 362

Dr. Bengtson, Professor of Geography, University of Nebraska, is consulting editor of the Prentice-Hall Geography Series. Most of his studies have centered in Latin America. Thruout his busy career he has maintained an interest in effective classroom teaching.

Are You a Malthusian? By Roderick Peattie 365

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Manioc. By Minnie E. Lemaire 376

Miss Lemaire, Associate Professor of Geography, Mount Holyoke College, is president of the New England Geographical Conference. She has also contributed articles to *Economic Geography* and *School Science and Mathematics.*

National Council at Work. By Loyal Durand, Jr. 386

Geographical Publications 387

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VOLUME XLIX DECEMBER, 1950 NUMBER 9

PUERTO PEÑASCO, SONORA

RONALD L. IVES

INTRODUCTION

Only a generation ago, Puerto Peñasco was a little-visited harbor on the Sonoran shore of the Gulf of California, serving as a port of call for a few fishermen, adventurers, and fugitives from justice. Land access was over a perilous 60 mile desert trail from Sonoyta, or an equally arduous desert traverse from Altar. Resident population was five, and there was only one permanent building.

Today, with construction of a large emergency landing field (1941), paving of a two lane highway to Sonoyta and Ajo (1946), and completion of the Sonoran Railroad (May 5, 1949), Puerto Peñasco has become a bustling community of 2,500 persons, supported by their work in the transportation and fishing industries. Population growth is rapid, market demand for refrigerated fish exceeds the current supply, ship building and repair work is in demand, and conditions are improving rapidly. In consequence, Puerto Peñasco has become a modern city of hope on the western bastion of the arid and unproductive Sonoran Desert.

PHYSICAL ENVIRONMENT

Location of Puerto Peñasco with respect to terrain and to the present Mexican and international transportation networks is shown in Fig. 1, a summary map from which minor details have been omitted.

The harbor, which makes the port a desirable anchorage, is a small embayment, protected on the north by Rocky Bluff, an ancient lava island, 400 feet high, tied to the mainland by a bar almost five miles long. General appearance of this tombolo is

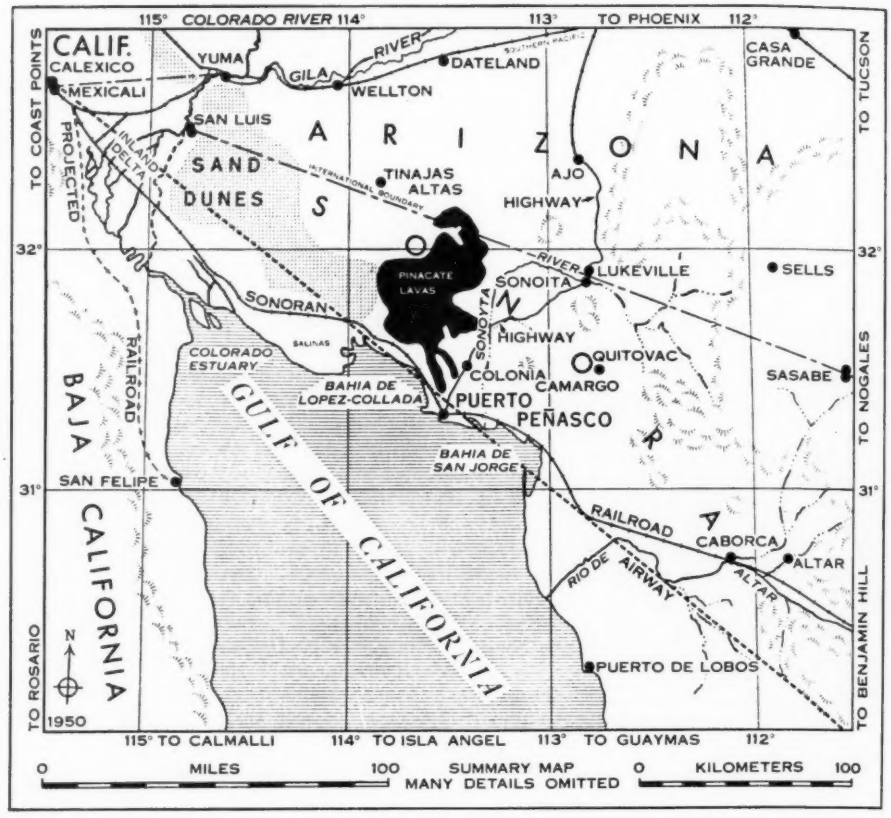

FIG. 1. Summary map of the area bordering on the head of the Gulf of California, showing location of Puerto Peñasco with respect to terrain and transportation routes.

shown in Fig. 2. The other shore of Rocky Point Bay (Bahia de Punta Peñasco), is formed by Rocky Point, a lava-capped hill of sand and gypsum, with a rock core, having a summit about 225 feet above sea level.

A shallow inner basin, isolated from the main bay by a curved elevated bar (Fig. 4, beach), fills at high tide, and is used for small boats and ship repairs. Man-made harbor improvements consist of a mole and a breakwater, arranged to give shelter to small boats.

South of Puerto Peñasco, for more than 20 miles, the Sonoran shore extends eastward, and is composed of a narrow beach bar, with a few lagoons behind it; a wide shelf, extending inland for several to many miles; an ancient shoreline, about 75 feet above the present beach; and an inner belt of desert deposit. The straight

shore of Sonora, south of Puerto Peñasco, is an almost barren desert, with no regular human habitations, no dependable water, no roads, and no resources. Even the desert-loving Seri Indians shun this region, which, until the recent development of the jeep, was almost impassible. General appearance of this barren and mirage-shrouded region is shown in Fig. 3.

FIG. 2. View of Rocky Bluff, an ancient tombolo, or tied island, from the south shore of Rocky Point Bay. Rock beach in the foreground is basaltic lava, eroded from Rocky Point, above Puerto Peñasco. Note ancient elevated shoreline on west (left) side of Rocky Bluff.

Temperature ranges at Puerto Peñasco are typical of the Sonoran Desert Region, with maxima of about 130° F. in summer, and minima of about 30° F. in winter. Average ranges are about fifteen degrees less, and daily ranges are about 35 degrees. Because of low relative humidity during the hotter parts of the year, and of a strong and fairly regular land-and-sea-breeze cycle, summer conditions at Puerto Peñasco are not unpleasant. In winter, flannel shirts and coats are desirable, but danger of frostbite is about nil. Rainfall is in the form of one or two violent summer squalls; with a quiet drizzle once or twice during the winter. Annual rainfall is about 5 inches, with great year-to-year variations.

Tropical hurricanes, altho not uncommon in the Gulf of California, rarely reach Puerto Peñasco, and cause little damage when they do, as a result of natural shelters, particularly Rocky Point.

FLORA AND FAUNA

Altho the hinterland of Puerto Peñasco is a desert, composed of sand dunes, gravel-floored valleys, and lava flows, it is by no means devoid of life. Almost every acre of Sonora, with the possible exception of some parts of the salt flats ("Salinas," Fig. 1), supports some life. Much of the area is covered by sparse clumps of sage, with occasional screwbean trees, and clumps of greasewood. North and east of Puerto Peñasco groves of giant saguaro

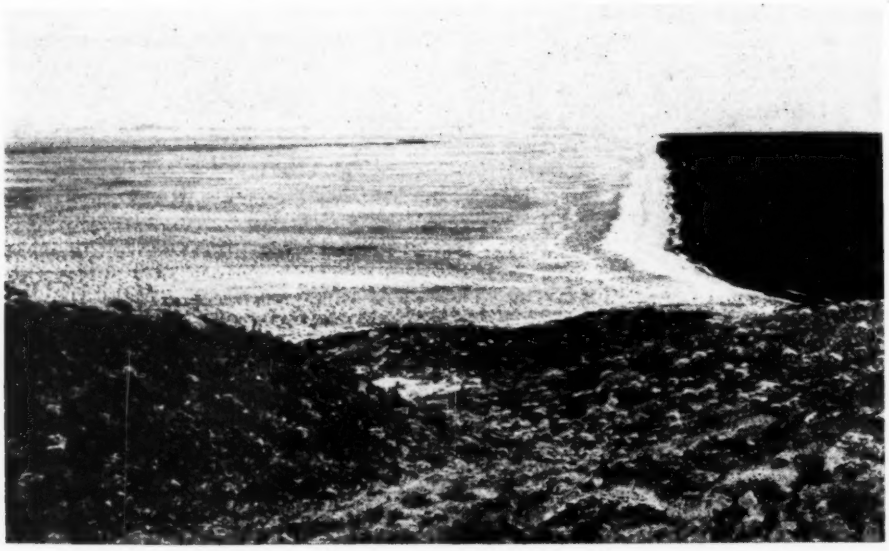

FIG. 3. The vast and arid "despoblado" south of Puerto Peñasco. Foreground material is black lava, forming the caprock of Rocky Point. Shore of the Gulf of California, with its wide beach, extends eastward for more than 20 miles. A small lagoon, perhaps the ancient drowned mouth of the Sonoyta River, interrupts the desert in left middle distance. Bases of the mountains, on the horizon, almost 70 miles away, are hidden by mirages.

cactus tower to heights as much as 30 feet. Along the ephemeral streams of the region, cottonwood trees are common, sometimes defining the dry channels for many miles.

Numerous insects, of varying rapacities, are prevented from overrunning the area by large numbers of small reptiles, mostly lizards, which prey upon them. Small rodents, many of them related to the ground squirrel, subsist on the grasses and cacti of the region, and in turn are eaten by the larger carnivores, of which coyotes are representative. Mountain sheep and wild donkeys are

the largest wild animals in the region, altho a few javelina are present. These are preyed upon by the local mountain lions and bobcats, both of which are hunted by men.

Birds include the Gambrel Quail, various hawks and buzzards, gulls, and a number of very small birds, such as the cactus wren, the cliff swallow, and at least two varieties of humming bird. A few horned owls and prairie owls have been seen in the region, but may be migrants or fugitives from other areas.

Unlike the land areas of Sonora, which are steppe and desert, most of the Gulf of California is populated to the limit of its supporting power by fishes of all kinds, many of them unclassified. Dense banks of seaweed furnish ample food for the smaller fish; these in turn are eaten by the larger fish, and also by seals and marine birds. Whales are not common in the Gulf of California, but Seri legends tell of a period of great prosperity in the past, "the year of the big fish," when a whale was stranded on Tuburon Island, and the Seris operated a meat mine for several months. Plentiful marine life in the Gulf of California supports the local fishing industry. In a few areas, notably at Bahia de Lopez-Collada (Fig. 1), shallow sea areas are separated from the Gulf by temporary sandbars, and here the waters become too foul to support marine life. Such euxine areas are commonly short-lived, but new ones are created by the same currents that disrupt the old ones.

TRANSPORTATION NETWORK

Transportation facilities to and from Puerto Peñasco are shown in Fig. 1, with a summary of terminal conditions in Fig. 4. At the present time, there is daily stage service to Sonoyta, with connections to Ajo (Arizona) and Gila Bend. Rail service consists of one passenger train daily each way to Mexicali, on the International Boundary; and three trains weekly each way to Benjamin Hill, on the railroad from Nogales to Hermosillo, the capital of Sonora. Freight service depends upon amount of material to be shipped. Sea transit is irregular, and is determined by demand. Air service over Puerto Peñasco is regular, but landings are made only in emergency. Charter air service to Puerto Peñasco from Mexicali, Nogales, and Hermosillo is available at standard rates.

Much passenger and freight traffic in this area is carried by non-scheduled vehicles, such as trucks, chartered ships, and planes.

Navigation aids at Puerto Peñasco consist of a lighthouse atop Rocky Point (Fig. 4) and a course beacon near it. Radio facilities are maintained at the airport and the Oficina de Comunicaciones. Despite isolation and high cost of equipment, the navigation aids at Puerto Peñasco are kept in excellent operating condition, due almost entirely to the diligence of the local residents.

CITY LAYOUT

Puerto Peñasco is an excellent example of a well-located community which has outgrown its site. The original town, now locally known as "Fishing Town," occupies a narrow bench on the northwest side of Rocky Point. This bench is probably an ancient shoreline, much like that on Rocky Bluff (Fig. 2). Upon the summit of Rocky Point, directly above Fishing Town, and easily accessible from it, is the lighthouse and the aeronautical course marker (Fig. 4). General appearance of the older part of Puerto Peñasco, which is now the administrative and commercial area, is shown in Fig. 5.

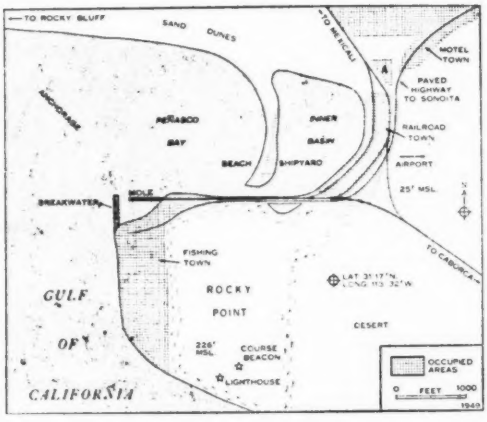

FIG. 4. Sketch map of Puerto Peñasco, drawn from photographs, showing subdivisions of the community, interrelations of transit routes, and major terrain features.

Because the original townsite was too small for the population and activities of the port, Puerto Peñasco has expanded onto the desert in every possible direction, and new segments of the city have grown up about various other centers of activity. The recent completion of the railroad led to the construction of the Railroad Town (Fig. 4). Local ship repairs and building necessitated a small group of buildings near the yards, which line the west side of the inner basin (Fig. 4, 6), and work related to road transportation led to construction of a modern Motel east of town. About this has grown up another settlement, locally called Motel Town, and occupied largely by freighters, mechanics, their families, and their local suppliers.

Already, a few houses have been built on the road leading to

the airport. Shortly, if present growth continues, particularly if the projected Mexicali-Peñasco-Hermosillo feeder airline begins operation, there will be a new section of the city—Airport Town.

At present, many of the buildings in Puerto Peñasco are of only one story, and many of these are temporary structures of wallboard and matting. This temporary housing is being replaced by sturdy one and two story buildings of concrete blocks as rapidly as the supply of concrete blocks permits.

New building construction, in general, is accompanied by some improvement of the building site, usually leveling, and bringing

FIG. 5. Older part of Puerto Peñasco, seen from the crest of Rocky Point. Here are concentrated the administrative and commercial functions of the city. Peaks on horizon are Sierra Blanca (right), and Pinacate Volcano (left). A part of the Motel Town is visible in upper right. Note shallowness of Peñasco Bay, in middle distance.

the lot to local grade. Some terracing of Rocky Point has already been done (Fig. 5), and low areas near the breakwater and mole (Fig. 4) have been filled in.

As should be obvious from the map (Fig. 4) the present layout of Puerto Peñasco is almost entirely functional, and, altho the community "just growed," it would be hard to improve upon the present relation of city plan to local topography and activities. It would, of course, be mechanically feasible to dig away much or all of Rocky Point, thereby enlarging the building area near the Fishing Town, but the highland is more useful as an elevation to support navigation aids, and, in the future, a reservoir. In conse-

quence, no effort is being made in this direction, altho residences may well be constructed on the summit in the near future.

ECONOMIC ACTIVITIES

There are about 2,500 people in Puerto Peñasco at present, and, of these, about 800 are gainfully employed. The remainder are wives and children. There appear to be no unemployed in the community; and no unemployables. Those who have no money and don't want to work avoid Peñasco—it is more pleasant to loaf elsewhere!

Major industries in Puerto Peñasco are fishing, transportation, and the various service industries related to them. About 50 vessels, of various sizes, are engaged in fishing at present in the Gulf of California near Puerto Peñasco. To process the catch for shipment, a medium-sized modern processing plant has been constructed on the shore, and an anchorage (Fig. 4), consisting of a mole and a breakwater, has been constructed on the south side of the bay, close to the plant, for convenient unloading of the smaller vessels and tenders (Fig 7). Present plans call for the construction of a long pier, on the site of the present mole, in the near future, so that unloading will be facilitated. Fish from Puerto Peñasco are sold not only in Mexico, at points accessible to the railroad, but as far away as Los Angeles, California, and Phoenix, Arizona. Projected improvements in the refrigerating plants will make possible regular shipments to Denver.

Because there is no agriculture near Puerto Peñasco, and no local water supply, transportation is a vital community function. Bulk foods, from Mexicali and Hermosillo, are brought in by rail. Surplus farm commodities from the Sonoyta area find a ready market in Peñasco, to which they are trucked over the paved highway. Some manufactured items are imported from the United States via Gila Bend and Ajo; others come in by rail.

All water used at Puerto Peñasco must be imported. Some is brought by rail, but most of this is required by the railroad installation, which is quite large, as Peñasco functions as a division point and maintenance center. A small amount of water is distilled from sea water, a costly process, using imported fuel, and reserved for acute emergencies.

Most of the city water is trucked in from Colonia Camargo, on the Sonoyta Road, a haul of about 12 miles. At Colonia Camargo

a deep driven well, tapping a buried aquifer which may be the subsurface flow of the Sonoyta River, supplies potable water in considerable quantities. Installation of a gasoline pump and storage tanks there has facilitated loading of water trucks. When the pump is shut down, it is sometimes necessary to go to Sonoyta, some 70 miles from Puerto Peñasco, for water.

Because Puerto Peñasco is a "turnaround" point for most

FIG. 6. Newer parts of Puerto Peñasco, photographed from the summit of Rocky Point. In foreground is the shipyard, on the inner basin. A small sector of the beach of the outer harbor is visible at the extreme left. In middle distance is a part of the Motel Town, and to the right of it is the paved highway to Sonoyta. White houses on far side of inner basin, to right of road (A in Fig. 4) are new, air-conditioned houses for railroad personnel. A small part of the railroad town is visible in extreme right. Pinacate Volcano is on horizon at left; Sierra Blanca in center.

vehicles, and a division point for railroad employees, there is a relatively large hotel and restaurant business. Altho lacking plush carpets, potted palms, and uniformed bellhops, the hotels of Puerto Peñasco function admirably, supplying clean beds in quiet rooms at moderate rates. The restaurants cater to people who must work for a living, and furnish good simple food at reasonable prices. Attempts are being made, with some success, to attract winter tourists to Puerto Peñasco, where the climate is quite pleasant, and the deep-sea fishing excellent.

Social Organization

Altho Puerto Peñasco is a new, and rapidly growing, community, having many of the economic aspects of a boom town, it does not suffer from the lawlessness and disorder characteristic of such communities in the early days of the settlement of the United States. The inhabitants of Puerto Peñasco are busy, orderly, and polite. The culture is definitely northern Mexican, even tho as many as ten different languages may be heard in the course of a day, and features and complexions indicate many racial origins. Perhaps the age and economic status of the inhabitants influences the nature of the community. In contrast to the young single men who established many of the cities of the western United States, many inhabitants of Puerto Peñasco are middle-aged, married, and financially stable, having attained some economic success in some other community before moving to the new seaport. Some of the residents are grandparents.

Administration at Puerto Peñasco is typical of many smooth-running Mexican towns, with a Comisario, Police Department, Postmaster, and Jefe de Comunicaciones performing all major governmental functions. The present city administration (1949) is quite obviously trying to do a good job, and is succeeding, with strong popular support.

Nautical functions are controlled by the Captain of the Port, who is responsible not only for recording the comings and goings of the various ships, but also for the care and maintenance of the navigation aids, the customs collections, and the multiple problems of harbor maintenance and improvements.

Education is an important city function, and is carried on in a newly-built school, which is already crowded with students. The teaching apparently is excellent, for many of the students can do complicated problems in foreign exchange without difficulty, and most speak English, as well as Spanish, clearly and correctly. Due to the success of the Mexican campaign against illiteracy ("analfabetismo"), most residents of Puerto Peñasco are not only literate, but very well informed.

Municipal health is quite good, as a result of the inherent ruggedness of the northern Mexican, aided by careful local sanitation, and the efforts of a resident physician. Altho water is scarce and expensive in Puerto Peñasco, buildings are kept very clean by sunlight, air and diligent sweeping.

Amusements are not numerous in Puerto Peñasco, nor are many needed, for the average resident must work hard for a living. Films are shown regularly, these being brought in by rail and bus from central Mexico, and from Los Angeles. Many residents own radios, and listen regularly to stations in both Mexico and the United States.

Small gatherings customarily meet in the local saloons, which function as a "poor man's club," much as does the English Public House. Both soft and hard drinks are served here, as well as food. Music is provided by juke-boxes, or by local talent, some of which is very good.

Business is conducted in a businesslike manner, most stores having standard prices for standard items. Stocks of merchandise

FIG. 7. Unloading fish from a tender in the small boat harbor behind the mole and breakwater at Puerto Peñasco. Western gulls, attracted here by "free eats," are both numerous and tame.

are quite good, and service is excellent. Most of the merchants try hard and successfully to send the customer on his way happy; and business ethics are high. Prices are reasonable, in view of the isolated location of Puerto Peñasco. Items manufactured in Mexico are sold for about the Hermosillo price plus cost of transportation; and items from the United States are sold at about the Phoenix price, plus haulage cost. Because of the exchange differential, imported items cost almost ten times as much as comparable items "Hecho en Mexico" (exchange is currently 8.5 pesos for one dollar).

FUTURE NEEDS AND PROSPECTS

As nearly as can be determined from personal observations, augumented by conferences with a number of community leaders, Puerto Peñasco is socially and economically healthy, despite its very rapid growth. Present growth rate suggests a population exceeding 5,000 by 1960.

In common with most other communities, Puerto Peñasco will soon be faced with a number of problems, solution of which may be quite difficult and costly. Chief of these, and the only one which may restrict the growth of the community, is the water shortage. The present supply, while adequate for immediate needs, is costly, and comes largely from one well—fortunately a good well, and carefully maintained.

Until more water is available, and at a low price, installation of running water in most of the houses at Puerto Peñasco is not economically feasible; and, without running water, a modern sewer system is impossible. Construction of a large reservoir atop Rocky Point will make possible gravity water supply to all buildings in the city, but some means must be found for filling that reservoir. At present (1950), no local water supply is known, and the well at Colonia Camargo cannot be pumped at a fast enough rate to supply a municipal waterworks, with its accompanying waste of water, much of it unavoidable. Present per capita water consumption in Puerto Peñasco is approximately five gallons per day, according to the water haulers. In most cities where water is piped to the houses, per capita consumption exceeds 200 gallons per day.

Coupled with the municipal water supply problem is the need for irrigation water, so that agricultural production will be possible from the arid, but potentially fertile, flatlands east of the city.

Search for underground water sources is being conducted by the Mexican Geological Survey, but the outlook for a discovery of such water nearer the city than Colonia Camargo is not encouraging. If plentiful water is found, even at a greater distance, a pipeline may furnish a costly, but workable solution to the water problem.

Harbor improvements needed to double or triple the capacity of the port are few, simple, and relatively inexpensive. Primary need is for a pier, to replace the present mole. This may be con-

structed with Government assistance, because of the strategic importance of the port. When traffic warrants, the inner basin (Fig. 4) can be converted to a tidal basin by installation of a single lock, and a small amount of dredging, the spoil from which could be used to fill in a number of low places adjacent.

SUMMARY AND CONCLUSIONS

Puerto Peñasco is an interesting example of the conversion of a potential resource—the fisheries of the northern Gulf of California—to a productive resource by construction of proper transportation facilities. Because the natural resource is real, and not imaginary, and the transportation facilities—a railroad and a road—function as planned, the resultant rapid growth of the city is exactly what might be expected. Present indications are that this growth will continue, and that a moderate-sized tourist industry will augument municipal income from fishing and related occupations.

From a national viewpoint, this development of Puerto Peñasco is extremely desirable, for it supplies homes and gainful occupations for several thousand citizens, furnishes a convenient division point on the Sonoran Railroad, and changes a part of the Sonoran Desert from a food-importing "despoblado" to an exporter of foodstuffs, largely fish, which are in demand in other parts of Mexico, and which are salable for scarce dollars in the United States.

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PETROLEUM IN RELATION TO CURRENT PROBLEMS—I. SHOULD AMERICAN PETROLEUM IMPORTS BE RESTRICTED?

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University of Nebraska, Lincoln

In peace as in war petroleum, the raw material for products essential for power and for industrial uses, continues to hold premier position. As of January 1, 1950, the estimated proved petroleum reserves of the world were 77,702,250,000 barrels of 42 gallons.* By "estimated proved reserves" is meant the petroleum believed to be recoverable from underground storage as indicated by wells drilled within pools and areas now productive. Proved reserves do not include untested areas nor do they imply proved in a definite and positive sense because even within so-called proved areas dry holes are often encountered. Nevertheless the estimates published represent the consensus of leading students, officials and statisticians actively at work in the industry.

This estimated world reserve is widely scattered over the earth from Tierra del Fuego to northern Alaska and in an east-west wide band around the earth. Altho petroleum is known to occur in every grand division, its uneven distribution has given rise to petroleum-rich and petroleum-poor countries. While the nearly 78 billion barrels of estimated proved reserves are the aggregate of at least 43 countries, only nine of them comprise the "inner circle," each credited with more than one billion barrels. These nine petroleum-rich countries named in order of their estimated proved reserves as of January 1, 1950, are, (1) the United States, (2) Kuwait, (3) Venezuela, (4) Saudi Arabia, (5) Iran, (6) Iraq, (7) U.S.S.R., (8) Canada, and (9) Indonesia. On a hemisphere basis, the estimated reserves are divided almost equally, 39,202,450,000 barrels being credited to the eastern hemisphere and 38,499,800,000 barrels credited to the western hemisphere.

Insofar as present data tell the story there is within each hemisphere one great center of known petroleum reserves and a few important lesser centers. In the eastern hemisphere the foremost center is in the Persian Gulf area including Saudi Arabia, Kuwait, Iraq, and Iran, while the flanks of the Caucasus and the Indonesian

* Most of the data presented in this discussion were published by the *Oil and Gas Journal*, issues of December 22, 1949 and January 26, 1950.

islands may be considered as the principal satellite centers. In the western hemisphere the foremost center of accumulation is in the plains area of the United States with satellite or lesser accumulations in Venezuela, southern California, and Alberta, Canada. In this résumé it will be observed that the eastern hemisphere includes six of the billion barrels plus countries while only three of the major group are in the western hemisphere. However, taken collectively, the foremost area of estimated proved reserves is the Middle East credited with 32,413,000,000 barrels while second place is held by the United States with reserves estimated as of January 1, 1950, at 25,909,000,000 barrels. Altho the United States has consistently provided from 60 to 70 per cent of the world's production during more than three quarters of a century, there still are within its borders about one third of the presently estimated world reserves of petroleum.

IMPORTS NECESSARY

In the United States the demand for petroleum products is so great that, even with production of crude oil reaching five million barrels or more daily, imports of crude to the extent of 400,000 to 500,000 barrels per day have become ordinary practice. In 1949 the imports of crude oil and refined products averaged in excess of 600,000 barrels daily. Since the capacity for production in this country is such as to supply most if not all the market demands, the problem of imports has become one of wide interest. Some favor restrictions or high import duties while others favor free and open competition among domestic producers. Congress is being urged by strong pressure groups to take action, each group acting largely on the basis of self interest. The public should consider rationally the basic factors involved, among which the following may be named.

In the first place it is apparent that production in the United States cannot long be maintained at the present rate of two billion barrels or more per year. If no new discoveries were to be made in this country our stores of liquid petroleum would become exhausted within fifteen years. New discoveries will be made, are now being made, and we should therefore not become suddenly alarmed at the prospect of early depletion. Nevertheless, oil in the ground when once taken out is not restored. Oil is not a self replenishing asset and hence the need for conservative use. Foreign oil will lengthen the life of American reserves.

Pump Wells

There is, however, another side to the picture. In this country a large percentage of our current production is supplied by pump wells with low daily production per well. At the close of 1949, the *Oil and Gas Journal* reported the total number of producing oil wells in the United States as 420,695 with average daily production of about 12 barrels per day. Six states, with a total of 135,578 wells, reported average production of less than 6 barrels per well per day. The daily average output of the 55,627 wells reported in Pennsylvania was only .6 barrel per day. To many people oil is a magic word, symbolic of wealth. They do not realize that oil involves heavy costs of production just as truly as does production of corn or cotton, and that costs must be met and some profits made or production will not be maintained. Furthermore if the hundreds of thousands of low yielding stripper wells were not maintained in production the reserves represented by them would become dissipated and lost. Therefore a reasonable price for crude must be maintained or we shall be in danger of losing a steady and dependable source of production of a vital national power resource.

Thus we face the problem of encouraging imports of crude petroleum as a need for American industry and also to prolong the life of our reserves. On the other hand, if we permit imports from the flush production of the Middle East or Venezuela in such quantities and at such low prices as to discourage continued production of our own pump or stripper wells, we would suffer irreparable loss. The problem of maintaining the proper balance between American domestic production and imports from foreign sources is one that involves consideration of the various geographic, economic, and political factors involved without losing sight of the conservation ideal—the best use for now and the future.

For classes in high school or college the question of limiting imports of petroleum by high duties or by quotas should be met fairly and openly. Propaganda either for or against must be avoided, and this can best be done by encouraging students to see that there are contrasting points of view, each with some facts to support it. As a result of such studies differences of opinion will probably develop, but each student should be able to defend his own view rationally and also to understand why others may differ with him.

ARE YOU A MALTHUSIAN?

A Review and a Bibliography of Recent Readings

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I have been reading books and articles on the coming scarcity of food and the almost startling increase of the world's population. Being a geographer I have had it called to my attention since I began studying in 1910, but the recent publications gave me fresh concern. It was Malthus that first said that food would normally increase in a mathematical ratio while population would increase in a geometrical proportion. Moreover, we have had since called to our attention that there is a limit to food production as the tillable land becomes completely settled. As an example, may I say that in Japan the level land used for rice paddies is decreasing in extent as they are using it for building houses for the extra population. The argument that starvation is facing the world is supported today by a group of thinkers known as the Neo-Malthusians, a group with sadly pessimistic minds.

Trained geographers, and I am not properly trained in economic geography, are versed in the array of facts brought out by the Neo-Malthusians. Agricultural experts have been calling to our attention that land has been decreasing thru erosion or being worn-out as exemplified by Jacks and Whyte in *Our Vanishing Lands* and Ward Shepard in *Food and Famine*. As head of the O.W.I. in South Africa, I was in contact with Hugh Bennett. After surveying the countryside, he gave the South Africans but 25 years before soil erosion would devastate the country to an extent where they would be in want of food.

ROADS OF EXTENSION

I was particularily shocked by reading William Vogt's *Road to Survival* and yet in reading it a second time I realized it was too pessimistic. And moreover, many of his statements did not take into account the measures that we are taking to preserve our food supply. His arguments are spotty and incomplete. Of Latin America on which he is best informed he says the continent is, except for 3 or 4 countries, overpopulated but he does not name them. This is true but the South Americans are behind in culture. He

fails to note that the main problem of that continent is the South Americans.

I am particularily interested in Africa. Vogt's treatment of Africa is incomplete and I suspect because he has a slight knowledge of that continent. Perhaps he is right in stating Africa will not support many more people. It did have a tremendous acreage of waste land, I can testify from personal observation, not only because of aridity but because of infertile soils. I saw huge areas of little use in food production. But, he does not know Africa and particularily the work of the British, Belgian and French agricultural agents, and what is being done to improve things. The British on the east and west coasts are doing grand work, tho by different means on the two sides. In the fine farming area about Salisbury in Southern Rhodesia I was shown excellent corn fields and was told that 95 per cent of them were contour plowed, a record that the United States for a similar area does not hold. The great concern with Africa as a food supply is there are four blacks to one white and the blacks are maturing to a position where they can take over the reigns of government. They then will save themselves from a diet of under nourishment and there will be less food for export. Sara Gertrude Millin, a South African whom I know, states this fear in the October, 1949 *Foreign Affairs.*

I suspect Vogt has read only very generally of China. We as Americans have made a significant improvement in China's food supply. In plant breeding, production per acre, and pest control, we and the Chinese have accomplished much. Buck in his "Fact and Theory about China's Land" in *Foreign Affairs* for October, 1949 tells briefly of some of the steps taken.

In describing India, Vogt has a right to be pessimistic tho it is proved that India can enlarge its food production by careful and scientific methods. Margaret Bourke-White in her *Halfway to Freedom* tells of the terrors involved with migrations in forming the two countries and lays the strife to religious wars. The real source, I am convinced, of the hatred and slaughter, is a struggle for land and food. But Vogt gives to us, if not the whole picture, a startling one that should surely make us thoughtful of the future. In a sense he is right. We have thoughtlessly wasted soil resources and we are increasing in numbers and the need of soil.

I was better pleased with Fairchild Osborn's *Our Plundered Planet.* In a sense the book is a more literary volume. But tho in

less detail than Vogt, it is nevertheless pessimistic. Osborn is also of the school of Neo-Malthusians. It is interesting, for example, what he says about Greece. Osborn notes that Greece had forested mountains, ample water supply, and productive soils to an extent that it had a high civilization. Twenty centuries after that we were forced to give to ruined Greece a loan of several hundreds of millions of dollars to aid its economy to prevent the Communists from taking advantage of its poverty. But the loan can never be paid back. The loan was made under political pressure but without an adequate consideration of the poverty of the land and the quality of life in Greece. It is a country hardly larger than Ohio and has a population equal to that state. But in Greece only 20 per cent of the land is tillable today. There is less than one acre per person, whereas 2.5 acres are considered necessary to maintain a European standard of living. And the soil is poor. None of that tilled land has the original top soil. Crops are grown on subsoil and only 11.5 bushels of wheat to the acre. Twenty-five to forty bushels are grown on other European fields. Moreover, the water supply is inadequate due to the depletion of the forests. The cutting of centuries, the burning of the forests and overgrazing by sheep and goats have brought destruction to the hillsides. And there is no wild-life left in Greece, a customary source of food.

In normal times Greece was forced to import one-half of its bread stuffs and three-fourths its rice; paying for it with tobacco, wine, currents and olive oil. These last three could have well been used at home. In the meantime, Greece was increasing in population until it had 770 persons per square mile of tillable land. We can not afford to permanently feed Greece. It is almost a hopeless problem.

Much of the Malthusian philosophy is said to have begun with Adam Smith (1776) and John Stuart Mills (1848). But Mills did not understand the remarkable expansion that began in 1800. They believed in a classic concept that everything was in a static condition, that there was a definite limit to resource production and a scarcity at that. And furthermore they saw in agriculture a law of diminishing returns. We still have that law in a textbook in economic geography which I am teaching today. It is only partially true. But not only with the new land of the Americas, Africa and Australia, they did not understand the revolution in agriculture

where Europe can raise as much as 40 bushels per acre where they used to grow 10. In 1898, Sir William Crooks said, "England and the civilized countries have not enough to eat" and that an increasing acreage of wheat land will feed the increasing population of the world, till 1931. Was he right? A recent statement in the *New York Herald Tribune* said that the dollar problem in England is in part because there are too many mouths to feed. On the increased acreage for wheat, one should consult O. E. Baker in a carefully written article in the Journal of Geography. Benjamin Franklin was worried about the food with which to feed the world and Jefferson in writing to Madison said, "When we get piled up one upon another—we shall become corrupt, as in Europe, and go to eating one another as they do there." What would Jefferson think of India today?

Of course, the Malthusians did not prophesy correctly for the next century. Not only did the production of food increase but there was not the increase of population in Europe that was expected. New lands were opened up, releasing millions in Europe as in North America, South America, Australia and Africa. At the beginning of the century the United States was still taking vast numbers of hungry people off Europe's hands, and we were sending one-fourth of our wheat and ship-loads of cattle to Europe. And we were optimistic as to the future. But are we today? Are we Neo-Malthusians or not? Louis Bromfield is not a Neo-Malthusian. In an article in the *Atlantic Monthly* of 1949 entitled, "We Don't Have to Starve," he is happy about the food future. In a way he is right. We of the United States do not in the near future have any need to fear, even if two-thirds of the world is hungry. But students in reading thought of Bromfield as far too optimistic in the article.

Let us face some facts before we make an answer.

Populations Are Seriously Increasing

Considering first, population growth, I have found that the estimates vary considerably. If I am challenged on my figures in any case I am right in saying that they are amazing.

In 1600 there were perhaps only 500,000,000 people alive in the world. By 1800 the population had increased twofold. There are about as many people in Europe today as there were in the world in 1600. It is estimated that there will be 500,000,000 increase in

world population in 25 years and the total world population would be about two and one-half billion.

In the United States, with a comparatively low birth rate, we are increasing at a rate far over 10 per cent a decade. A recent news item states it was a 20 per cent rate in the last 9 months. Certainly in a century we will have doubled our population unless we grow less sentimental about having babies. I would say that I am contributing to this increase. I recently have produced three grandchildren and I am at the prime of life and I have only begun my stride in producing grandchildren. China and India will double their population in 100 years and without my help. The United States has now two and one-third acres of tillable land to support a person. India has but two-thirds of an acre for the same purpose or one-seventh of the area we have. What will be the history of food nutrition in India? Already they are slaughtering off people as there is not enough food for all. China has 2 million people starving today. This is not a special year of poor crops but a normal year. The answer is not enough land.

Japan has 2,532 people to the square mile of available land, the Netherlands have 2,085, Norway has 1,660 and the United States but 221. About one-half of the Japanese are farmers but we must remember that the country also depends upon fish from the sea. Japan's 76 million are increasing at the rate of 1 million yearly. The U.S.S.R. in a century may have 400 to 500 million. They have the highest birthrate of all, about 40 per thousand people. India has 30 and the United States only 16 to a thousand, in spite of my personal efforts to build up the second generation.

J. J. Spengler in an article "The World's Hunger—Malthus, 1948," in the *Proceedings of the Academy of Political Science* gave a remedy for over-large populations. The remedy is birth control, capital formation, diffusion of science and engineering knoweldge, and the removal of civil and international strife. The article is an excellent one and has a large bibliography. Mr. Spengler is an economist of Duke University and like all economists can not write without using the world capital. By capital formation he refers to an industrial development which will enable a country to purchase more food. But in the world picture according to the Neo-Malthusians there shortly will be no surplus to export. The removal of civil and international strife is important. I have only to mention China as of today or to take an example better known

to us, Germany. The significance of science and engineering is great. It saves me from being classed as a Neo-Malthusian.

REMEDIAL WRITINGS

We are leaders in engineering from an agricultural point of view. Our national and state governments are the best in the world on preaching to the farmer the need of soil conservation, the betterment of crops and the improved techniques of farming. They have even reached the economists. Harold J. Moulton in his excellent book on *Controlling Factors in Economic Development*, 1949, gives a summary of the efforts of the United States to grow more food and to increase our standard of living. True we are one of the best fed nations of the world today, along with certain other countries, mainly some of the British dominions but definitely we are interested in the future. The book, however, is explaining the basis of a national prosperity. Again, being an economist he goes into an explanation of national economics as a changing thing rather than a static concept held by the old school. Not being an economist, I follow the idea thru with difficulty. But he is against the law of diminishing returns in agriculture. In the last century because of machinery he notes that in terms of increase in the output per man per hour is equal to all the centuries put together. The law applies to an extent in intensive cultivation of the land. In the growing of wheat we were using 50 to 60 hours of man hour labor to an acre of land in 1830. By 1930 we were using less than 8 hours for the same operation. For corn there was a savings of 50 per cent. Tho costs do not primarily concern us, the increase of dollar costs between 1900 and 1940 increased 90 per cent. This gets him to the question of capital and like all economists is off on a favorite subject.

The interest in more production of the land is great and is the object of investigation by agricultural engineers the world over. The United Nations Scientific Conference on Conservation and Utilization of Resources had 500 papers by men of 50 nations. The list of papers covers every conceivable resource. Agricultural economists and agronomists say that food is in increasing amounts and capable of untold increase. The American Association for the Advancement of Science held a conference in 1940 to that end. Incidentally at that meeting it was claimed that with better varieties of rice and agriculture in China and India, these countries

would feed 56 million extra people. Bradfield in an article on "Soil Productivity and the Potential Food Supply of the United States" says that our country can feed 50 per cent more of a population and it will support with an increased acreage and an agriculture of the future, a population double the present numbers with a standard comparable with ours. His is a remarkably worthwhile one to read. His article appears in the *Proceedings of the Academy of Political Science* and is a worthy one.

Soil conservation is definitely a first step to be taken in regards to our securing proper amounts of food. Our soil is such an important natural resource that in a socialized democracy such as we have today it is of prime importance. When I was in South Africa in 1945 I was talking to farmers, and the talks frequently went to the question of soil erosion. I could tell them in those days that 145,000 acres daily were added voluntary to county soil organizations which guided and indeed forced soil erosion prevention on their members and you could travel from Virginia to Texas without setting foot on land that was not under such organizations. The movement came into being while the Democratic Party was in power, but it was a more deep-seated activity than a party policy. I am a Democrat and I entered the state of Vermont some twenty years ago, where I bought a farm, a lone Democrat among Republicans. I had an eroded field, the north field. Farmers would come by, Republicans all of them, and looking at the field, complained that I was not planting trees to prevent erosion. I was busy with other things but in the end their arguments won and I planted trees. I did not have a right to waste the national resource even to the slight degree of a couple of gullies. By preventing the erosion I was admitting that the land was not mine but that I merely had the right to use the land according to national needs. In a manner I was curtailing my privilege of private enterprise and I was approving further socializing of the government in regard to natural resources. Many of my critics voted largely on the basis of preventing any interference with their private enterprise but were unconsciously agreeing to it.

I need not tell you of the destruction of the country's soil that has gone on by erosion. I lived for a time on the Mississippi Delta and the river day in and day out was carrying the fine top soil to the amount of huge trains constantly rolling to the sea. In addition to the references I have already cited, I would refer you to the

standard work of H. H. Bennett entitled *Soil Conservation.* For those who want easy reading on the subject I suggest Louis Bromfield's "Soil Conservation" in the *Proceedings of the Academy of Political Science.*

Bennett says, "We have some land left that has not been used; but it is scattered. We have no large aggregates of land to which we may turn. We are losing every day as the result of erosion the equivalent of two 140 acre farms. We have lost that much since we were here yesterday. It is gone, gone forever. . . ."

Let me present a single fact from C. Lester Walker, *Man and Food—The Lost Equation.* He says that 75 million acres in Indiana, Ohio, Pennsylvania, Kentucky and West Virginia have been developed to corn culture and have suffered greatly from erosion. Annually they would have lost less than 3 tons to the acre and that would be replaced by natural soil farming processes. But these fields largely on hillsides were losing the startling amounts of 99.3 tons per acre. I have been on fields in the Cumberland Mountains which produced corn only for 3 years after they were cleared. Fields were exemplified by Walker as having produced 69.5 bushels to the acre but with the top soil gone would only give less than 20 bushels.

But Bradfield notes that even tho soil has been farmed by soil-depleting crops as in the Eastern United States, that experiments have proven that these depleted soils can be built up to a fertility which is above the original virgin soils.

Besides the loss of soils physically there is a decreased fertility. This we can build up. Malabar Farm has been built up by Bromfield. He points out that we have not utterly destroyed our land as have the Asiatic and Mediterranean countries but can develop our farms to a reasonable productivity. He has built up Malabar Farm to a marvelous degree. An example is of his meadow supporting a cow and a half to an acre for 6 months pasturage and on the other side of his line fence a farmer needs six acres to support one cow. On the other hand he is against the use of excess chemical fertilizers which he claims can be destructive to good farming. Rather he is for animal fertilizers, the growing of legumes which give nitrogen and the plowing of straw and waste under the ground. We are using sewerage more than we used to and Europe is likewise using it. But despite advances in agricultural techniques the world's soils are diminishing in fertility. It is true

we concerned ourselves over the problem. I believe it was William Allen White who said no money was ever made out of our farms except as we dug into the principal.

Of course, there is the program of increased acreage as a remedy. Canada and Siberia are examples. But these northlands will be limited in the amount of food they can produce. There are the jungle lands. Earl Parker Hanson in his *New World Emerging* is an enthusiast for tropical lands. He has written a book not wholly convincing but it has some truth in it. I flew over the edge of Amazonia and the center of the Congo. In the Congo I saw a great possibility and some definite development. In the Amazon, in my brief flight, I saw little hope.

Insect control has taken great advances. Ten per cent of the world's crops are ruined by insects. In the United States $20,000,000 worth are annually destroyed. We are gaining on the insects rapidly by new drugs and new methods of applying them. Even the airplane is used successfully.

FURTHER OPTIMISTS

Greater opportunity is not acquired in food production by increased area but rather by increasing crop yields. In Denmark and the Netherlands crops of over 40 bushels of wheat were produced when the world's average was 15 bushels to the acre. This was due to a better rotation of crops, the intelligent combination of animal and mineral fertilizers and the careful selection of seed forced upon the farmer by higher taxes. The same is true of wheat growth in the United States. Wheat is seldom produced in the State of Maine. But when it is grown they must get a yield of 30 bushels to pay taxes on the land. In the Dakotas 15 bushels will be profitable. In a recent issue of *Life Magazine* there was an article on hormones produced artificially which promoted plant growth. They have been effective in making the pineapple crop of Hawaii more productive and in the Western States the apple crop was giving seven million extra bushels of the fruit annually when dusted with hormones. I have no need to tell about the importance of hybrid corn. It has increased our yield tremendously. Recently it was introduced to hungry Italy and the results were astonishing. Bromfield claims that the Southwest was under a sub-normal rainfall for three years and yet they had bumper wheat crops. This was because the wheat straw of the last year's crop was chopped up

and worked 5 inches underground by sub-soilers which rip up the ground to the depth of 20 inches and give air and moisture. All the water falling on the soil is salvaged even though it is of a torrential sort.

Gilbert White, a geographer, has written an excellent article, one worth while for your reading. It is entitled, "Towards an Appraisal of World Resources—New Views of Conservation Problems." It is made complete with an extensive and varied bibliography on conservation. It is anti-Malthusian. His conclusions are that balanced appraisal of world resources, which is the only solid basis for an answer to the current question of population outdistancing resources, is slowly taking place.

Sir E. John Russell gives a meaty reply to Aldous Huxley, a Neo-Malthusian, in *Food and People,* a UNESCO publication. He disagrees with the arguments of Huxley completely. In fact Huxley's points are born of a general pessimism and are not well founded. Russell is a leading agricultural expert of England. His thesis is that the way of mankind has always and will always be hard, but that well directed he will solve his problems. In a relatively short article he masses together a great many facts and it is most interesting. He even has hope for India.

The United Nations Food and Agricultural Organization is much concerned over the question and doing some excellent work, but it is not doing enough. Blair Bolles in a very short article on "Food and Diplomacy" tells some of the things they are doing.

Norris Dodd, director general of the F.A.O., tells us of two plans to increase the world's food supply. One is to train men to teach people in backward areas or under-developed countries in producing more food. Van Valkenburg of Clark University has been chosen head of a committee by the International Congress of Geographers to do exactly the same thing. In a recent number of the *Readers Digest* is the story of a practical missionary in Iran who is leading the way to make abandoned Iran produce fine crops. The second plan is for nations producing a surplus to continue to do so without danger of a price breakdown by having the surplus sent to areas in need of food. Lack of transportation and a failure of economics have caused many a famine. I have it from a Chinese student that they are suffering from lack of food on the densely populated Chinese coast while in the interior there is no suffering. This plan is an excellent one.

In Moulton's book he has a chapter on "Potentials of the Next Century" in which he states that when one contemplates the progress made in the last 25 years, the prospect for the next century can hardly be overestimated.

Well, I am worried about the future of world food. And I am worried about the present situation. And I am worried about the world if we have another war. But if we have peace, and if we have some sort of international co-operation, and if we put our brains together, and if I can slow down in producing grandchildren, I believe we will have at least two good meals a day.

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MANIOC

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Manioc, a most important plant of the tropics, if mentioned at all in most economic or regional geography books, generally receives more or less passing notice. Very likely this results from the difficulties in trying to find accurate information concerning this crop and from the fact that it does not enter into a major role as an export-import product. Yet we find it ranking at least among the five oldest cultivated plants in the western hemisphere and possibly as old or older than any cultivated plant of the eastern hemisphere. Manioc is one of the most important plants, along with maize, which the West has given to the East and today it probably rates as one of the ten or twelve most important sources of food in the world and bears a rank of first order as a foodstuff for millions of people in the tropical countries thruout the equatorial zone. In South America it has the same relationship to the tropics as the "Irish" potato has to the highlands.

NAME-ORIGIN

The plant has various names in various regions and this, too, represents a difficulty in tracking down information. Contained in the list will be yuca, yucca, manioc, mandioca, cassava, casabi, manihot and guacamote (Mexico). The Aztecs in Mexico gave it the name "tree-potato." Tapioca—a refined product of manioc—derives from a Brazilian word meaning "pudding."

As with many plants the exact center of origin cannot be definitely located. Certainly the pre-Columbian period saw it well established in many sections of northern South America, Central America, and the West Indies. At least forty-two species are spontaneous in America, mostly in Brazil, some in the Guianas, Peru and Mexico, but not one in the old world. Most authoritative sources claim that manioc is indigenous to Brazil because here are found the greatest number of plants, wild and cultivated, the largest number of names for the many varieties of manioc and a great relative dependence on this product as a food in the subsistence culture of the natives.

The Portuguese traders early transported and introduced manioc to the Western Congo area where it is now one of the most

important foodstuffs. The spread to the rest of Africa as well as to the Southeast Asiatic area such as Malaya and the East Indies, especially Java, took place during the 16th and 17th centuries.

Botanically manioc belongs to the spurge or milkweed family (Euphorbiaceae) and has a milky fluid or latex. Other members of this family group are Hevea rubber, poinsettia and castor bean.

FIG. 1. Mandioca—about 8 months old—near Marilia, Brazil.

The principal value of manioc lies in its tuberous roots. Of the numerous species of manioc, Manihot esculenta or Manihot utilissima seem to be most commonly cultivated (Fig. 1).

CHARACTERISTICS

The plant is somewhat shrubby and ranges in height from 3′–18′ (Fig. 2). Bitter and sweet manioc, probably developed from offshoots of the same species, represent two varieties of the plant. Both contain a glucoside closely related to prussic or hydrocyanic acid, which at times is quite toxic and deadly. The poison is found in the skin or just beneath the skin and may be removed by heating the root because the acid is volatile, or by pressing out the juice. Sweet manioc, generally used for food, contains less acid than the bitter manioc, preferred in the commercial field, but there

is evidence to show that sweet manioc contains a much larger amount of prussic acid when moved from high altitudes to lower elevations. The length of the growing period seems to have some influence on the amount of poison because it builds up to a maximum in about six months and then the percentage progressively diminishes.

In the time scale of growth, the plant is ready in 10–18 months for forage, in 15 months for the table and in 18–24 months for the more demanding and particular industries. The percentage of starch in the roots reaches its maximum (and probably its optimum) at 20–22 months when it may be expected to be 35 per cent by weight. The Saracura variety of Brazil is claimed to have a 36.69 per cent starch content but, overall, a normal figure of expectancy would be 25 per cent. Two maxima in the growth period are recorded; one after 9 months when the plant has lost its leaves and the second at the end of another year when the root has doubled in size but has somewhat more than doubled its starch content.

Conditions—Requirements for Growth

Manioc, not requiring great care and easily cultivated, produces more food by weight per unit of area than any other food crop. Propagation is done by planting 8″–10″ cuttings from the middle portion of mature stalks about two-thirds in the soil and 4′–6′ apart. Ninety per cent germination is the general rule. The plant has few serious pests and diseases and one of the worst is Xanthomonas manihotis, a wilt disease first isolated from Manihot utilissima in Brazil. When grown for subsistence the problem of storage is easily solved by leaving the crop in the ground until needed.

Climatically speaking, manioc is grown in most of the A zone (Köppen)—Af, Am, Aw, in some of the C zone—Cw in America and South Africa, Cfa in America, and in some of the B area in America. Altitudinally it may be found from sea level to 7,000 feet. This infers that the frost free period extends for at least eight months, altho ten–eleven months provide a much heavier yield. For the most part growing is restricted to areas having a mean average temperature of about 76°F. with a slight range. It produces in areas having less than 20″ precipitation as well as in those having 100″ or more. A fairly high relative humidity de-

mand means that coastal areas are preferred. In Java, because the crop requires less water than many other tropical crops, cassava goes on non-irrigated lands. The practice in the past has been to plant before the rains but lately in sections of Brazil new plantings have been made in May-June to escape the rains inasmuch as it has been found that rain keeps leaves and above ground stock growing well but roots do poorly. Also such planting seemingly reduces bacteriosis—one of the diseases.

Swampy and saline areas are prohibitive to growth while light, rich sandy loams furnish ideal settings. The soils should be dry rather than wet. Because of manioc's drought-resistant nature it is especially well developed for sandy soils and for soils too dry for maize and many other tropical crops. Water is needed at the

FIG. 2. Mandioca root—grown to supply a flour mill then under construction on a fazenda near Marilia, Brazil —August, 1940.

beginning for sprouting but once the plant has taken hold seldom will it be a total failure in a long-continued drought period. If an underlying hardpan is present, roots will be prevented from penetrating too deeply. Because manioc is one of the plants least exhaustive to the soil, it should be seriously considered as a replacement or rotation crop for some of the more demanding ones such as maize.

AREAS OF GROWTH

Most of the areas producing manioc lie within the belt 30°N.–30°S. with slight poleward distensions principally into Brazil, the

United States and China. In the eastern hemisphere the Netherlands Indies' chief root crop, especially Java, is cassava which serves as a native food crop as well as for tapioca. The plant is almost entirely cultivated by the natives and is often used as a sort of extra plant because it is inexpensively and easily handled and yet gives large paying returns for the labor. The eastern regions of Java have the greatest concentration of growing fields. The manufacture of tapioca and other cassava products is generally handled by Europeans and Chinese.

The cassava plant was early introduced by the Spanish in the Philippines but apparently no great production was attained for the record shows 316 acres devoted to the crop in 1903. The islands of Cebu, Albay and Palawan account for about one-third of the production. Something of the same story is found in Hawaii where the 1919 record shows a production of 182,500 pounds valued at $1882 and the 1930 record—1 acre on Maui. In Guam, Manihot—an indigenous starch-bearing root—yields cassava and tapioca. In New Guinea an inferior quality product grows as a weed in native gardens but it represents an excellent reserve item and probably should receive more careful attention as a regular crop. Other South Asia continental regions and islands which produce varying amounts are India, Burma, Ceylon, British Malaya, Straits Settlement, Unfederated Malay States, Siam and Indo-China. In Madagascar it is cultivated, by Europeans and natives alike, thruout the whole island except for areas above 1800 meters and in the desert regions of the southwest.

Africa has developed quite a dependency upon manioc. Three major agricultural regions as defined by Shantz list this as a major item. 1) Tropical forest, oil palm, rubber, cacao, banana, rice, manioc, chicken, goat region. Here in the Belgian Congo, Nigeria, Dahomey, Ivory Coast and Liberia sections manioc is interplanted with bananas, rice and maize until manioc gradually eliminates the others. 2) Tropical fruits, root crops, vegetables, maize, chicken and goat region. This area is poleward of the first and includes, in part, southern Belgian Congo, southern and central parts of French Equatorial Africa, southern Anglo-Egyptian Sudan, Portuguese Guinea and the Gold Coast. Here manioc is outstandingly important as the chief food product, so much so that it leads to a most unbalanced diet with resultant poor health. 3) Manioc, millet, sorghum, maize and livestock region. A belt pole-

ward of the second type, again, in spite of a drier climate, relies upon the starch from this root crop for a major portion of its food.[1]

In the United States because of the crop's preference for coastal regions with a relatively high humidity and a high temperature, only along the Gulf Coast from Florida to Texas can be found a suitable area for growth, but so far the farmers have not indicated much interest because maize suits them better. That which is grown is primarily the sweet cassava. In Mexico the states facing the Gulf Coast, Vera Cruz, Oaxaca, Tabasco, Yucatan and Chiapas cultivate with the greatest abundance. The Antilles group, especially the Dominican Republic, have a long history of use and need.

In Venezuela the small patches of manioc bear the name "conucos." In the eastern and southern parts of the country Manihot utilissima dominates, apparently indicating the influence of migrating Carib Indians, whereas Manihot Aipi—a sweet cassava—has become the favorite in the central and western sections.

In Brazil and Paraguay, the Tupi and Guarani Indians used mandioca as a basal stock in their shifting agricultural pattern. In Brazil, today, the Executive Commission for Mandioca Products which was organized in 1942 as an attachment to the Federal Ministry of Agriculture supervises and initiates developmental plans, organizes and aids producer cooperatives, institutes production and marketing controls, has control over milling equipment and other installations and generally watches the whole industry. Subsidization of the national mandioca flour industry by requiring a mixture of mandioca in wheat breads existed in 1940 but apparently has been stopped, probably because of trade dealings with Argentina where wheat constitutes a prime consideration.

PRODUCTION

As with any crop, production figures per unit area vary considerably but some comparative statements are useful. For instance manioc may yield up to 16–40 metric tons per acre, the normal flour yield being one-third to one-fourth of the weight of the root, and thus one acre can feed anywhere between 12–30 people. This means that the crop is about six times as effective as

[1] Shantz, H. L., Agricultural Regions of Africa, *Economic Geography* XIX, 1 [1943], 77-109.

wheat as a food producer. However lower figures of production seem to be an actuality. In Java, the variety Mandioca Sao Pedro Preto averages 20 tons per acre, while Mexico plans on obtaining six tons per acre. Generally the sweet varieties have a lower yield than the bitter ones, 10 tons as compared with 15 tons per acre.

The leading producers by countries, by acreage and by tonnage, appear for the most part in the following order—The Dutch East Indies, Brazil, Madagascar and French West Africa. In spite of poor statistics it probably can be truthfully stated that today both Asia and Africa surpass the Western Hemisphere as a producer.

Manioc as a Food

Manioc, as a foodstuff, constitutes a staple element in the diet of millions of people in Africa, the East Indies and other regions of Asia even tho it is recognized as inferior to maize. The American area still harbors a great interest in maize and beans; however, manioc rates first in Paraguay in tonnage and second in Brazil (sugar cane is first) and in other areas it appears on the menu twice a day almost every day in the year. The variety of forms of preparation is quite surprising. The leaves may be cooked as greens and the sweet manioc may be served as a vegetable, as for instance, like potato or parsnip.

Probably the greatest use is as a coarse meal or flour ("farine" or "Farinha") as bread or cakes. The Indians scrape or peel the bitter manioc, grate it and squeeze out the poisonous juice. Then the raw pulp is dried and sifted, made into thin cakes and cooked on a terra cotta pan or griddle. One advantage of farina is that it will not deteriorate if kept for a long period of time and will not be injured by insects. In Brazil variations on the plain use are many, for example, manioc flour seasoned with palm oil and pepper and mixed with boiled shrimps, locally known as Vatapá; or Farofa —toasted manioc flour; or Beiju Curuba—a fancy variety, prepared from grated cassava mixed with grated Brazil nuts; or Beiju Teyca—where grains of starch are allowed to adhere during the heating and make a most delicious confection when rolled up with butter, syrup or fruit preserve; or frozen Acaça—a jellied mass of manioc flour that has first been boiled in water, seasoned with salt and served on a dish of heavy banana leaves, fresh and pretty and green. The preparation of mandioca for home use involves rather

simple processes and can be done by almost any peasant at a relatively low cost.[2]

As might be expected of such an important crop, it also appears as a beverage where it might be served as an intoxicating drink somewhat resembling beer, as a warm drink such as Mingau—a sweetened hot drink of tapioca, water and milk—or as a tall cool drink with water, lemon and sugar.

In the temperate areas cassareep—the juice of the bitter variety—forms the base of the famous Worcestershire and other sauces and is finding increased use as a meat preservative.

Not only does cassava serve man's needs but it has also been found to be a good feed for stock, that is cattle, dairy animals, hogs and poultry. True, the feed is highly carbonaceous and needs to have nitrogenous grain feed mixed with it, but it is one of the most inexpensive feeds that can be grown.

USES OF MANIOC—COMMERCIAL

Up until the present, manioc constitutes the cheapest known source of starch and is much in demand by the natives in Java for laundry purposes and Brazil manufactures much starch as a sizing for its fast growing textile industry. At the Stica colony in Piribebuy, Paraguay, construction of a manioc starch factory was under way by February, 1948 and should add materially to the improvement of agriculture in the area.

Industrially the crop is processed in four general forms—dried slices, meal and flour, flakes and pearl tapioca, and compressed residue, with the United States importing principally flour and tapioca. Commercial production began in the 19th century in the East Indies and the Indian Ocean islands sponsored mostly by the Dutch and French.

As a starch it does remarkably well as a remoistening glue for postage stamps and the import of tapioca in the United States for the manufacture of adhesives and of paper sizes has shown remarkable growth lately.

Tapioca, as a substitute for wheat flour, enters into competition with arrowroot in biscuits, crackers, buns and porridges, because

[2] Landes, Ruth, *The City of Women*, Macmillan, New York, 1947 and Pickles, Alan, Cassava in the Amazon Valley, Agricultural Society, Trinidad and Tobago, Proceedings v. 42, pt. 2, June 1942.

it is easily digested. Probably the best and most widely known use of cassava in this country is that of Minute Tapioca—A General Foods product—with its plant located in Orange, Massachusetts.

With the increased knowledge derived from chemurgy this crop may very likely be one of the cheapest sources of alcohol, acetone, dextrin and glucose. In those areas where distilleries have been established with sugar as the chief source material and thereby run a rather short season, cassava may be used to feed the factories in the so-called off season and thus make for more efficient units and operation. Brazil stands to especially benefit from such an arrangement and experiments are already being carried out with this in mind.

TRADE IN MANIOC

Trade in manioc began fairly late for apparently it first appeared as an article of trade about 1896. Altho cultivation of manioc covers a wide latitudinal and longitudinal range, exports come from relatively limited sections. Before 1941 the Dutch East Indies, Madagascar, British Malaya, Indo-China, Brazil and the Dominican Republic held the export spotlight. As the exports originated in relatively few areas so likewise do a few countries dominate the import trade. The United States has led as a consumer nation, and, in Europe, Great Britain has ranked as the largest importer with France next. These three have generally controlled the import market.

Java and Madura, until the 1940's easily led in exports. Java's product has attained a good reputation and has had little competition in the United States and British markets. The second World War disrupted this market and altho the Java and Siam product has started to reappear the quality has been poor. As might be expected Madagascar depended on France as its chief market. Indo-China and Reunion also furnished the French with a portion of their imports.

The products which are exported do not have clear-cut definitions from one country to another but the names appearing most consistently are manioc meal, manioc starch, manioc roots, tapioca, tapioca meal, tapioca pearl and seeds.

Because the production of manioc in Brazil has not been efficient (thus boosting production and marketing costs) or qualitative, this country, ordinarily, cannot meet competition in a number of

the foreign markets. The boom periods of both World I and II gave Brazil a start but a drop followed immediately after the 1917-1918 peak and is following the same trend today. In an attempt to maintain at least a good part of the trade in the coming years the General Foods Corporation has aided and encouraged the growth of manioc for commercial purposes by trying to be objective in setting up specifications for grading the product, by coding the product, by correlating data on analysis of the samples taken, by supplying services of technicians to the producers and by trying to stabilize the market before reentrance of Java into the foreign trade market. In order to further show their interest their Minute Tapioca Division purchased about 7000 tons in 1948. Estimates indicate that Brazil in 1942 was manufacturing about 35,000 tons. Figuring that the United States ordinarily will consume 110,000–150,000 tons then Brazil could obtain a fair proportion of the United States market if this were all exported.

CONCLUSION

With the great interest in the tropics and their development it would seem that considerably more attention should be given to manioc and its place in the economy of countries, not only for its fool value but also for its industrial and commercial potential. With the plans now being initiated, such as the Ten Year Development Plan of the Colonial Ministry of the Belgian Congo issued in June, 1949, the opportunity is present and more thought should be spent on servicing the immediate area with its own products rather than servicing the needs of the temperate areas. A more adequate knowledge of the tropics, in tropical terms rather than in middle latitude jargon, might be started with a good evaluation of what manioc has to offer now and in the future.

THE NATIONAL COUNCIL AT WORK

Four committees of the National Council have made reports; these reports are considered by the Executive Board and the Publications Committee. If the report is of 1. general interest and use to all geographers, and 2. useful in the field of teaching it may be issued as one of the special publications of the National Council, such as a Professional Paper. Two such professional papers are now in process of publication: 1. the report of the *Committee on Preparation of Bibliographies on Lists of Maps* and 2. the report of the *Committee on Compilation of Suggestions and Bibliography for Use by Curriculum Committees.* The first named committee report was prepared by Mrs. Katheryne T. Whittemore, *Chairman,* Margaret Chew, and George Corfield; the second-named report was prepared by Mamie L. Anderzohn, *Chairman,* Annice D. Elkins, Monica Kusch, and Villa B. Smith. Two additional committees, which reported to the Executive Board November 24 and 25 at the Chicago Meeting, are 1. the *Committee on Color Transparencies* and 2. the *Committee on Survey of Research in Geographic Education.* A preliminary report of the Color Transparency Committee was published in the JOURNAL OF GEOGRAPHY, Vol. 49, No. 5, May, 1950, pages 200-206. Miss Elizabeth Eiselen is Chairman of the committee.

Professor Arthur W. Carthew of Los Angeles City College has accepted membership on the *Committee on Tests.* Mr. Carthew has had wide experience in testing, and has made many contributions to this subject in his home college and state, and thru his work with the California Council of Geography Teachers.

Among those who served as hosts and hostesses at the Chicago meeting (the list is *not* complete as this goes to press) were: Barton, Byron K., Eastern Illinois State College, Charleston; Branom, Fred K., 10325 Leavitt St., Chicago 43; Burgy, J. Herbert, Dept. of Geography & Geology, Bradley Univ., Peoria 5; Calef, Wesley, Dept. of Geography, University of Chicago, Chicago; Colby, Mrs. Charles C., Navy Pier School, Chicago; Cunningham, Professor Floyd F., Southern Ill. University, Carbondale; Finney, Mrs. Mildred, Navy Pier School, Chicago; Gross, H. H., Concordia College, 7400 August St., River Forest; Kohn, Dr. Clyde F., Dept. of Geography, Northwestern Univ., Evanston; Kusch, Monica, Navy Pier School, Chicago; Neuman, Harold L., 2719 Noyes St., Evanston; Reineman, Martin, Dept. of Geography, Northern Ill. State Teachers College, DeKalb; Trager, Louise M., Lakeview High School, 4015 N. Ashland Ave., Chicago 13; and Wetterlund, Alice, 10960 Prospect Avenue, Chicago 43.

Miss Mamie L. Anderzohn of Oak Park served as the Coordinator of local arrangements. The National Council expresses its gratitude to Miss Anderzohn and the others who contributed so much to the meeting.

LOYAL DURAND, JR.
President

GEOGRAPHICAL PUBLICATIONS

James C. Malin. **Grassland Historical Studies: Natural Resources Utilization in a Background of Science and Technology.** Vol. 1, Geography and Geology. (Printed by the author, 1541 University Drive, Lawrence, Kansas. Lithoprint from typescript; paper cover) 1950. **$2.50.**

This is the first of three projected volumes which, the author explains, are to contain only fragments of a series of full-length books originally planned. Despite its title, the present volume consists of two specialized and disconnected parts. The first is called "Wood and Minerals for Fuel and Building Materials" and is devoted essentially to the interesting story of the geological exploration of Kansas and Nebraska and its influence on immigration as revealed by contemporary accounts, especially of the period 1840-1860. The second and longer part is devoted to the early history of Kansas City, Missouri, especially in the eighteen-fifties and 'sixties. Again there are numerous quotations from contemporary sources, including many from local newspapers and journals long since forgotten. Full details are given of trade and commerce in certain years and one is able to form a very clear picture of the city in its pioneer days. Reproductions of some early prints add to the interest of the volume.

University of London L. DUDLEY STAMP

Mel Scott. **Metropolitan Los Angeles: One Community.** 181 pp., 31 maps and plans. 107 illustrations. The Haynes Foundation, Los Angeles. 1949. **$5.00.**

The author of this book has recognized the need for up-to-date materials on the Los Angeles area and has planned the book to serve as a supplementary text for senior high school classes in Los Angeles and Orange Counties. The book should be extremely valuable and interesting, however, to all citizens—especially to the teacher of elementary and secondary students.

In an age when urban centers are continuing to grow (the 1950 Census shows that 104 cities now top 100,000) it is necessary that materials be made available on the nature of the urban environment in order that future citizens can understand better the problems of living in large urban centers. This book on the Los Angeles metropolitan area makes such information readily available for instructional purposes.

The author, Mel Scott, is well qualified to write on metropolitan development and planning. He has served as a consultant in urban redevelopment and has aided in the development of community study programs in San Francisco and other Southwestern urban centers.

Mr. Scott opens his book with a short chapter on the natural conditions and population facts of the area. The beginning of the metropolis is outlined in Chapter 2 and its historical development is brought up to date in Chapter 3. Subsequent chapters present discussions of the character of its population, its economic activities, public utilities, transportation facilities, the nature of metropolitan living, education, recreation, and the social problems which accompany that urban growth. The final chapter demonstrates the necessity for over-all planning for the metropolitan area and outlines how this objective can best be achieved.

The book is excellently and profusely illustrated with photographs, maps, and other visual aids. Especially noteworthy are the land use maps of selected cities within the metropolitan region.

Teachers of geography at all levels of instruction will find the book valuable not only for the facts that it contains, but more for the analysis that Mr. Scott makes of the problems of urban growth characteristic of all American metropolitan centers.

Northwestern University CLYDE F. KOHN

L. S. Berg. **Natural Regions of the U.S.S.R.** Translated by Olga Adler Titelbaum; edited by John A. Morrison and C. C. Nikiforoff. xxxi and 436 pp. The Macmillan Company, New York. 1950. $10.00.

This translation of Professor Berg's *Priroda SSSR* (1937) continues the selected series now appearing under the Russian Translation Project of the American Council of Learned Societies, and constitutes the project's second translation of a geographical work, the first having been Balzak, Vasyutin and Feigin's *Economic Geography of the U.S.S.R.*, which was issued in 1949. Since the *Economic Geography* approaches its subject from the standpoint of commodities and specific industries, it was accompanied in the original by a parallel textbook of regional economic geography which, unfortunately, has been unavailable for translation. The present volume thus represents an admirable choice for translation on the part of the committee, for it not only helps in part to fulfill the lack of a regional work, but makes available to American students the summation of a lifetime of observation and study by one of the Soviet Union's preëminent naturalists and physical geographers.

Berg's "natural regions" consist of climate and vegetation belts over the lowlands of the USSR, and of specific mountain groups elsewhere, within which the climate, relief, soils, vegetations, and animal life are successively described. Although geological influences on landforms frequently are referred to, there is no attempt to consider economic mineral resources. (The tone thruout is politically dispassionate.) The several climate and vegetation maps of the original edition have been redrawn and are included; in addition, physical landscape elements are effectively illustrated by more than eighty photographs which were especially gathered for the American edition and form a valuable amendment. The volume is excellently indexed, and the editors have added a glossary of the more frequently used English and Russian technical terms.

Indiana University WILLERT RHYNSBURGER.

Thomas R. Carskadon and Rudolph Modley, **U.S.A. Measure of a Nation.** Paper. 101 pages. The Macmillan Company, New York, 1949.

A vivid pictograph presentation of the economic life of the United States. Expenditures for: Food, Liquor and Tobacco; Clothing, Jewelry and Personal Care; Housing; Household Equipment and Operation; Medical Care; Education; Transportation; Recreation; Religion and Private Social Welfare. A forecast of expenditures in 1960 in each of these categories, and an estimate of additional expenditures needed to meet minimum requirements for all our citizens.

Pictographs also present: Past and Future Spending for Capital Goods; Cost of a 15-Year "Better City" Program; Cost of a Regional Development Program; Money Spent for Government Services; General Government Expenditures, a Look Toward the Future; Public Debt per Person. The Public Debt diagrams showing the vast increase of debt since 1913 are enlightening as well as depressing. Nothing is given, however, on taxes, direct or hidden.

This graphic presentation of our country is worthy of a careful appraisal by high school students. It should arouse many questions as to policy in relation to facts.

John Hay High School, Cleveland, Ohio VILLA B. SMITH

Status of Little Dixie in Missouri and, Robert M. Crisler, 337
Lloyd, Trevor, Progress in West Greenland, 319
——, To the Arctic! Jeannette Mirsky (A Review), 131
Los Angeles: Its Aquatic Life Lines, Oscar Osburn Winther, 45
McCrosky, Theodore T., Charles A. Blessing, J. Ross McKeever, Surging Cities (A Review), 259
McCune, Shannon, Confusion in Asia, 177
McKeever, J. Ross, **Theodore T. McCrosky,** Charles A. Blessing, Surging Cities (A Review), 259
Malin, James C., Grassland Historical Studies: Natural Resources Utilization in a Background of Science and Technology (A Review), 387
Mallinson, George G., The Relationship Between the Work of Elementary Science and Geography Teachers, 206
Malthusian, Are You a? Roderick Peattie, 365
Manioc, Minnie E. Lemaire, 376
Manufacturing: What Is It? Geography of, John W. Alexander, 284
Map Knowledge for Grade School Geography Teachers, **Lyda Belthuis,** 99
Maps and Their Use in Geographic Education, A List of Articles on, 288
Mediterranean, The World's Greatest Inland Sea—the, W. O. Blanchard, 232
Method and Its Limitations, The Sample Study—A, Gladys M. Hickman, 151
Methods of Teaching Geography in a Teacher Education Institution, Changing Attitudes with Different, Herbert Vent, 253
Mexican Mercados, Minnie B. Tracey, 78
Mexican Pueblo in Transition, A, Ruth Hoffman Stanley, 269
Miller, Elbert E. and Richard M. Highsmith, Jr., The Hop Industry of the Pacific Coast, 63
——, and Robert C. Burnham, A Simple Rain Gauge, 121
Minadeo, Guy, Creative Work in Geography, 123
Mirsky, Jeannette, To The Arctic! (A Review), 131
Misner, Paul J., Geographic Approaches to Social Education, Clyde Kohn, Editor (A Review), 130
Modley, Rudolph and Thomas R. Carskadon, U.S.A. Measure of a Nation (A Review), 388
National Council of Geography Teachers, Annual Meeting of the Thirty-Fifth Year, M. Melvina Svec, 114
National Council at Work, The, 42, 86, 125, 175, 212, 257, 301-302, 344-346, 386
Nelson, Howard J., Urban Geography in the High School, 313
Newbigin, Marion I., Southern Europe: A Regional and Economic Geography of the Mediterranean Lands (A Review), 347
Oasis, The Sonoyta, Ronald L. Ives, 1
Ouren, Tore and Axel Sømme, Trends in Inter-War Trade and Shipping (A Review), 216
Pacific Coast, The Hop Industry of the, Elbert E. Miller and Richard M. Highsmith, Jr., 63
Parker, Edith Putnam, Overcoming Undesirable Influences of Informal Education, 89
Parker Receives the Distinguished Service Award in Geographic Education, Edith Putnam, 40
Patterns in High School Geography, World, Zoe A. Thralls, 22
Peattie, Roderick, Are You a Malthusian?, 365
——, The Racial Problem of South Africa, 57
Petroleum in Relation to Current Problems—I. Should American Petroleum Imports Be Restricted?, Nels A. Bengtson, 362
Photograph: A Key to the Cultural Landscape, The Aerial, George A. Stokes, 32
Physical Geography of the Kunming Basin, Yunnan Province, China, Benjamin A. Tator, 103
Platt, Raye R., Isaiah Bowman 1878-1949, 174
Powers, William E., Polar Eskimos of Greenland and Their Environment, 186
Principles and Laws of Economic Geography, Some, George T. Renner, 14
Prizes, Journal of Geography, 41
Projects into the College Classroom, Bringing Grade School, Ernest S. Dix, 329
Pueblo in Transition, A Mexican, Ruth Hoffman Stanley, 269
Puerto Peñasco, Sonora, Ronald L. Ives, 349
Racial Problem of South Africa, The, Roderick Peattie, 57
Rain Gauge, A Simple, Elbert E. Miller and Robert C. Burnham, 121
Renner, George T., Some Principles and Laws of Economic Geography, 14
Rhynsburger, Willert, Fundamentals of Economic Geography, Nels A. Bengtson and William van Royen (A Review), 176
——, Natural Regions of the U.S.S.R., L. S. Berg (A Review), 388
Robertson, Ina Cullom, Steps in Map Reading, Mamie L. Anderzhon (A Review), 303
Ronne, Commander Finn (U.S.N.R.), Antarctic Conquest (A Review), 303
Rural Educators and Geographers, Common Goals for, C. O. Fitzwater, 239
Sahli, John R., A Study in Geography World Relations, 29

Sample Study—A Method and Its Limitations, The, Gladys M. Hickman, 151
Science and Geography Teachers, The Relationship Between the Work of Elementary, George G. Mallinson, 206
Sciences in the Cleveland Schools, The Relation of Geography to Other Social Studies and Physical, Clyde F. Varner, 164
Scott, Mel, Metropolitan Los Angeles: One Community (A Review), 387
Shanahan, E. W., South America, An Economic and Regional Geography with an Historical Chapter (A Review), 44
Shaw, Earl B., National Council at Work, 43.
Shepard, Francis P., Submarine Geology (A Review), 130
Smith, Villa B., U.S.A. Measure of a Nation, Thomas R. Carskadon and Rudolph Modley (A Review), 388
Social Studies and Physical Sciences in the Cleveland Schools, The Relation of Geography to Other, Clyde F. Varner, 164
Sømme, Axel and Ouren, Tore, Trends in Inter-War Trade and Shipping (A Review), 216
Sonora, Puerto Peñasco, Ronald L. Ives, 349
Sonoyta Oasis, The, Ronald L. Ives, 1
South Africa, The Racial Problem of, Roderick Peattie, 57
Stamp, L. Dudley, Grassland Historical Studies: Natural Resources Utilization In A Background of Science and Technology; Vol. I, James C. Malin (A Review), 387
———, Southern Illinois, Executive Committee on Southern Illinois (A Review), 347
Stanley, Ruth Hoffman, A Mexican Pueblo in Transition, 269
Stokes, George A., The Aerial Photograph: A Key to the Cultural Landscape, 32
Stone, Adolph, Western Germany, 83
Stoneman, E. A., Southern Europe: A Regional and Economic Geography of the Mediterranean Lands, Marion I. Newbigin (A Review), 347
Svec, M. Melvina, Annual Meeting of the Thirty-Fifth Year National Council of Geography Teachers, 114
Symonds, Clare, A Geography Assignment and Some of the Results, 159
Tator, Benjamin A., Physical Geography of the Kunming Basin, Yunnan Province, China, 103
Taylor, Griffith, Urban Geography (A Review), 88
Teaching Geography at the College, University and Graduate Level, An Appraisal of, Lewis F. Thomas, 133
Thomas, Lewis F., An Appraisal of Teaching Geography at the College, University and Graduate Level, 133
Thralls, Zoe A., World Patterns in High School Geography, 22
Tracey, Minnie B., Mexican Mercados, 78
Transparencies with a Source List of Color Transparencies, Values and Problems in the Use of Color, Elizabeth Eiselen, 200
Trans World Airlines (Prepared by G. Etzel Pearcy) Invitation to Italy (A Review), 216
University and Graduate Level, An Appraisal of Teaching Geography at the College, Lewis F. Thomas, 133
Urban Geography in the High School, Howard J. Nelson, 313
Van Cleef, Eugene, Building Atlanta's Future, John E. Ivey, Jr., Nicholas J. Demerath, Woodrow W. Breland (A Review), 259
Van Cleef, Eugene, Surging Cities, Theodore T. McCrosky, Charles A. Blessing, J. Ross McKeever (A Review), 259
Van Royen, William and Nels A. Bengtson, Fundamentals of Economic Geography (A Review), 176
Varner, Clyde F., The Relation of Geography to Other Social Studies and Physical Sciences in the Cleveland Schools, 164
Vent, Herbert, Changing Attitudes with Different Methods of Teaching Geography in a Teacher Education Institution, 253
Verbalism Looms, John Hayes Edwards, 171
Village of Cotocollao, Ecuador, A Geographic Study of the, Lea T. Hearn, 225
Vitaliano, Charles J., Submarine Geology, Francis P. Shepard (A Review), 130
Vough, Maude, Adventure in Geography in Second Grade, 26
Wantland, L. M., Geography is Vital to the Business Student, 243
Warman, Henry J., A Graduation Program with Geography as the Core Theme, 119
Warrington, Alexander, Economic Geography Lecture Material, 248
West Greenland, Progress in, Trevor Lloyd, 319
Whitaker, J. Russell, Out of the Earth, Louis Bromfield (A Review), 260
———, Topography of Roman Scotland, O. G. S. Crawford (A Review), 88
Williams, Joseph E., A Globe-Map Activities Program, 141
Williamson and Franklin Counties—Coal Counties of Southern Illinois, Arthur H. Doerr, 193
Winther, Oscar Osburn, Los Angeles: Its Aquatic Life Lines, 45
World Patterns in High School Geography, Zoe A. Thralls, 22
World Relations, A Study in Geography, John R. Sahli, 29

The Journal of Geography

Contents for Volume XLIX, 1950

JANUARY

The Sonoyta Oasis ..... Ronald L. Ives 1
Some Principles and Laws of Economic Geography ..... George T. Renner 14
World Patterns in High School Geography ..... Zoe A. Thralls 22
Adventure in Geography in Second Grade ..... Maude Vough 26
A Study in Geography World Relations ..... John R. Sahli 29
The Aerial Photograph: A Key to the Cultural Landscape ..... George A. Stokes 32
Edith Putnam Parker Receives the Distinguished Service Award in Geographic Education 40
Journal of Geography Prizes 41
The National Council at Work 42
Editorial Notes and News 43
Geographical Publications 44

FEBRUARY

Los Angeles: Its Aquatic Life Lines ..... Oscar Osburn Winther 45
The Racial Problem of South Africa ..... Roderick Peattie 57
The Hop Industry of the Pacific Coast ..... Elbert E. Miller and Richard M. Highsmith 63
Mexican Mercados ..... Minnie B. Tracey 78
Western Germany ..... Adolph Stone 83
The National Council at Work 86
Editorial Notes and News 87
Geographical Publications 88

MARCH

Overcoming Undesirable Influences of Informal Education ..... Edith Putnam Parker 89
Map Knowledge for Grade School Geography Teachers ..... Lyda Belthuis 99
Physical Geography of the Kunming Basin, Yunnan Province, China ..... Benjamin A. Tator 103
Annual Meeting of the Thirty-Fifth Year National Council of Geography Teachers ..... M. Melvina Svec 114
A Graduation Program with Geography as the Core Theme ..... Henry J. Warman 119
A Simple Rain Gauge ..... Elbert E. Miller and Robert C. Burnham 121
Creative Work in Geography ..... Guy Minadeo 123
National Council at Work ..... Loyal Durand, Jr. 125
Editorial Notes and News 126
Geographical Publications 131

APRIL

An Appraisal of Teaching Geography at the College, University, and Graduate Level ..... Lewis F. Thomas 133
A Globe-Map Activities Program ..... Joseph E. Williams 141
The Sample Study—A Method and Its Limitations ..... Gladys M. Hickman 151
A Geography Assignment and Some of the Results ..... Clare Symonds 159
The Relation of Geography to Other Social Studies and Physical Sciences in the Cleveland Schools ..... Clyde F. Varner 164
Verbalism Looms ..... John Hayes Edwards 171
Isaiah Bowman 1878-1949 ..... Raye R. Platt 174
National Council at Work ..... Loyal Durand, Jr. 175
Editorial Notes and News 175
Geographical Publications 176

MAY

Confusion in Asia ..... Shannon McCune 177
Polar Eskimos of Greenland and Their Environment ..... William E. Powers 186

CONTENTS

Williamson and Franklin Counties—Coal Counties of Southern Illinois ..... Arthur H. Doerr 193
Values and Problems in the Use of Color Transparencies with a Source List of Color Transparencies ..... Elizabeth Eiselen 200
The Relationship Between the Work of Elementary Science and Geography Teachers ..... George G. Mallinson 206
Interest-Stimulating Device ..... W. O. Blanchard 211
The National Council at Work ..... Loyal Durand, Jr. 212
Editorial Notes and News 210, 213
Geographical Publications 216

SEPTEMBER

Conservation—An Immediate Concern to All Nations ..... Halene Hatcher 217
A Geographic Study of the Village of Cotocollao, Ecuador ..... Lea T. Hearn 225
The World's Greatest Inland Sea—the Mediterranean ..... W. O. Blanchard 232
Common Goals for Rural Educators and Geographers ..... C. O. Fitzwater 239
Geography Is Vital to the Business Student ..... L. M. Wantland 243
Economic Geography Lecture Material ..... Alexander Warrington 248
Changing Attitudes with Different Methods of Teaching Geography in a Teacher Education Institution ..... Herbert Vent 253
Geography and Municipal Bond Analysis ..... Lawrence A. Kratz 255
National Council at Work ..... Loyal Durand, Jr. 257
Editorial Notes and News 258
Geographical Publications 259

OCTOBER

Chicago's Coal: Its Origin, Movement to Market, and Use ..... Arthur H. Doerr 261
A Mexican Pueblo in Transition ..... Ruth Hoffman Stanley 269
Alaska and the Alaska Highway ..... E. Franklin Fisher 278
Geography of Manufacturing: What Is It? ..... John W. Alexander 284
A List of Articles on Maps and Their Use in Geographic Education 288
National Council at Work ..... Loyal Durand, Jr. 301
Geographical Publications 303

NOVEMBER

Asia Looks At Latin America ..... George B. Cressey 305
Urban Geography in the High School ..... Howard J. Nelson 313
Progress in West Greenland ..... Trevor Lloyd 319
Bringing Grade School Projects into the College Classroom ..... Ernest S. Dix 329
The Regional Status of Little Dixie in Missouri and Little Egypt in Illinois ..... Robert M. Crisler 337
National Council at Work ..... Loyal Durand, Jr. 344
Geographical Publications 347
Editorial Notes and News 348

DECEMBER

Puerto Peñasco, Sonora ..... Ronald L. Ives 349
Petroleum in Relation to Current Problems—I. Should American Petroleum Imports Be Restricted? ..... Nels A. Bengtson 362
Are You a Malthusian? ..... Roderick Peattie 365
Manioc ..... Minnie E. Lemaire 376
National Council at Work ..... Loyal Durand, Jr. 386
Geographical Publications 387